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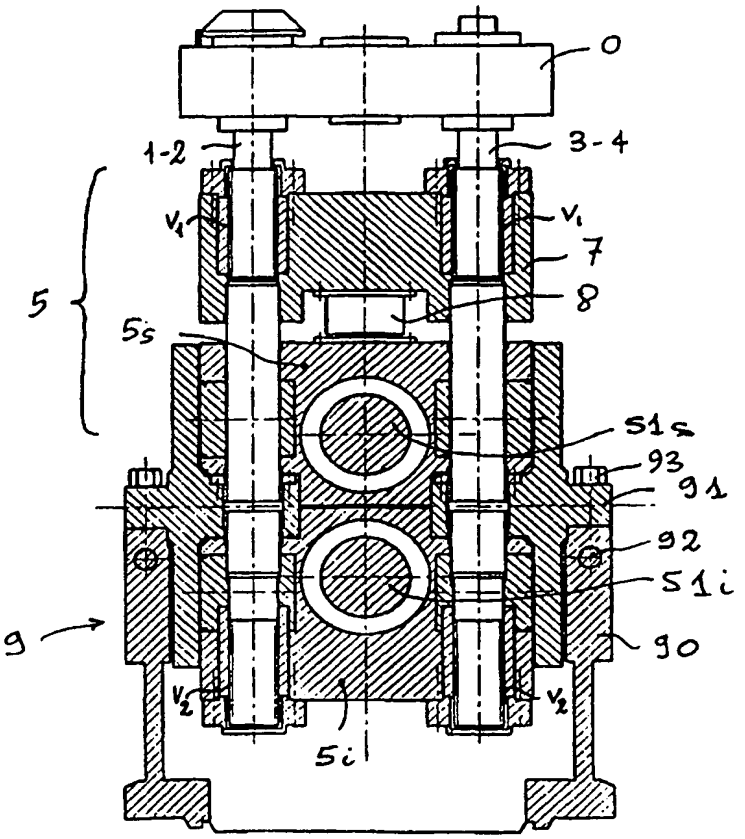
(54) Title: IMPROVED SERVO-ASSISTED ROLLING STAND

(57) Abstract

Two-high rolling stand, of the type involving the possibility of orthogonally moving the respective cylinders (51s, 51i) respect to the rolling axis and in movement which brings them away and close to one another by means of the sliding of the respective cylinder-holding packings (5s, 5i) along four tie-rods (1, 2, 3, 4) placed at the respective four angles of the stand case (9; 90-91), each threaded with opposite right-hand or left-hand screws (V1, V2) for moving in opposition the cylinder-holding upper packing (5s) and the cylinder-holding lower packing (5i), where it is provided at least: an external bridge part (7) which is engaged by coupling with the respective threadings of said tie-rods (1, 2, 3, 4) and an internal part (5s Fig. 1; 5i Fig. 3; 5s-5i Fig. 4) which makes up the real cylinder-holding packing, which is guided and slides axially along said tie-rods (1, 2, 3, 4) in a corresponding unthreaded part of these same, and in which said external bridge part (7) is connected by engagement to the respective cylinder-holding packing (5s Fig. 1; 5i Fig. 3; 5s-5i Fig. 4) by means of at least one approaching/removing means with fluid-dynamic cylinder (8) able to remove or approach or more or less press said internal part which makes up said cylinder-holding packing respect to said bridge (7) on the base of a determined quantity of fluid let in or let out by said approaching/removing means (8).



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DESCRIPTION

IMPROVED SERVO-ASSISTED ROLLING STAND

This invention has for object a rolling stand with servoassisted adjustment.

In prior art it is known the advantage of adjusting automatically during the rolling process the position of the rolling cylinders to adapt progressively the pass to the needs of progressive reduction of the thickness of the rolled section.

It is known that the rolling products, during their rolling, have a temperature variableness in their length and therefore a yielding variableness (compression strength or pressing strength), what determines different loads on the cylinders, that is different yielding of the structure.

Thus if the tail of a rod is colder than the head, during the rolling, the thickness of the rolled section tends to be higher on the tail because of a slight yielding of the cylinders which under a higher stress are more spaced (presence of unavoidable slacks and higher bending stress), or vice-versa in warmer areas of the rolled section.

In a word the presence of different temperatures (example between head and tail) causes the problem of the traditional stands of obtaining products not homogeneous in their size because of the different rolling loads deriving from the uneven temperature.

All this brings to the impossibility of obtaining rolled products with lower tolerances with the traditional rolling stands, particularly for the rolling of long products.

The servoassisted adjustment of the rolling cylinders is traditionally adopted for the large products rolling, that is sheet plates, bands and

large flats and this is carried out by using a quarter-stand involving two upper hydraulic jacks which press on the upper cylinder so to adjust it automatically in lowering and lifting.

Thus by suitable servocontrols of the prior art it is possible to automatically adjust the pass thickness during the rolling phase.

The same need exists presently in the hot rolling of long products (wire-rod, wire, rod, rod sections, etc....).

The existing adjustment art for the rolling of long products is still carried out mechanically by manual screw systems or by electro-controlled reduction gears which anyway need a lot of maintenance.

For such reason the applicant himself asked for an application for a servoassisted adjustment stand with an Italian Patent application IT-UD94A000189.

This solution proposes the realization of a two-high rolling stand, of the type involving the possibility of moving orthogonally the respective cylinders removing and approaching them from one another by the sliding of the respective cylinder-holding packings along four tie-rods placed at the respective four angles of the stand's plan, where at least at one end of each of said tie-rods, is applied an hydraulic jack which, fastened to the end of each of said tie-rods, acts by pressure or by retraction against the respective packing which carries the respective rolling cylinder.

This solution even if advantageous involves the problem of moving the whole stand bulk and anyway it is very complex.

The purpose of this invention is that of considerably simplifying the self-adjustment system of the distance between the cylinders of the rolling stand, which can be a two-high or a three-high stand, both before and during the rolling so that the cylinders modify their distance

according to the variation of the characteristics of the section being rolled.

This and other purposes are reached as claimed by the realization of a two-high rolling stand, of the type involving the possibility of moving orthogonally the respective cylinders respect to the rolling axis and approaching and moving away from each other by the sliding of the respective cylinder-holding packings along four tie-rods placed at the respective four angles of the stand's case, each threaded by a right-hand and left-hand screws opposite to one another for moving the upper cylinder-holding packing and the lower cylinder-holding packing in opposition, characterized in that:

- at least one of said packings is made up of two parts:

• an external bridge part which is tied by coupling to said respective right-hand o left-hand threadings of said tie-rods and

• an internal part which makes up the real cylinder-holding packing, which is guided and slides axially along said tie-rods into a corresponding unthreaded part of these same, and in which

- said external bridge part is connected and tied to said internal cylinder-holding part by at least one approaching/spacing means with fluid-dynamic cylinder able to move away or approach or either more or less press said internal part which makes up said cylinder-holding packing respect to said bridge on the base of a determined amount of fluid let in or let out by said approaching/spacing means.

Thus the rolling problems are solved in a simple and safe way and it is possible to carry out in a precise and reliable way a complete automatic adjustment of the pass depths also during the rolling.

This solution differs from the others because the continuous micro-spacing between the rolling cylinders during the rolling phase is not

obtained by screw systems but with a fluid-dynamic system by outlet or inlet of a predetermined volume of fluid in said approaching/spacing means.

This solution is also much more simple and reliable respect to the previous solution taught by the IT-UD94A000189 of the same applicant, where it was suggested the use of four hydraulic cylinders (jacks) connected, directly to the tie-rods inserted in the packings.

Advantageously the four tie-rods are kept in a fixed position by the single rotation by a base or retaining case which supports a retaining and guiding quadrangular semi-case which, besides maintaining in position said tie-rods, contains and guides also the respective cylinders-holding packings.

As much advantageously said four tie-rods are controlled rotationally in unison by an upper gear transmission system (preferably with a worm screw transmission driven by a varying-gear motor of known art).

The control of the fluid-dynamic cylinders (oil-hydraulic) is obtained as per traditional art by a feeding through servo-valves, safety valves and locking valves. The system pressure is assured by an hydraulic station and by a systems of accumulators.

In the station the fluid is conditioned, that is filtered, cooled or heated, by means of a separate circuit.

The control of the cylinders position is assured by the linear transducers connected to the movement of the packings and by pressure measurers which are inserted in the same hydraulic jacks.

May be provided some small blocks which slide on the stand vertical guides for the axial locking of the rolling cylinders. The system for the fluid inlet to the hydraulic jacks (cylinders) may be adjusted also by optical sensors of the temperature of the advancing rolled section or also

by measurers in continuous (for example laser measurers) of the variation of the rolled section, etc. This being neither restricting nor determining for the invention purposes.

The advantages obtained by this solution are substantially the following ones:

-position control (port between the rolling cylinders) during the same rolling.

- possibility of interventions for corrections in very short time;
- higher precision in the positioning, that is in setting the calibration;
- control of the rolling scraps through the control of the hydraulic pressure with no insertion of load cells.
- possibility of obtaining rolled products with smaller tolerances on the whole rod length also in the presence of different temperatures (example between head and tail) which with traditional stands would cause products not dimensionally homogeneous because of the different rolling loads deriving from the uneven temperature;
- possibility of automating and controlling the whole rolling mill in real times;
- simpler and more economical solution;
- higher compactness in the rolling equipment.

These and other advantages will appear from the following description of a preferred simplified embodiment solution relative to the enclosed drawings.

Figure 1 is a cross-sectional schematic view on the vertical plan orthogonal respect to the cylinders axis, passing through a couple of tie-rods of a rolling stand with servoassisted adjustment according to this invention.

Figure 2 is a front schematic view.

Figures 3 and 4 represent schematically other two solutions, respectively the first one spread out flat respect to the solution of Figures 1 and 2 and the second one with the application of the above mentioned device in the specific case for a three-high stand.

Of course the solution in Fig. 4 may be applied also to a two-high stand.

In the figures, by 9 is shown the case as a containing base of the whole rolling group.

The containing base supports a case 91 dismountable, upturnable by screw means 92, 93 which guides vertically the respective cylinder-holding packings, upper 5s and lower one 5i which include the respective rolling cylinders (51s, 51i).

The same case 91 holds and guides vertically fixed the four tie-rods (1-2; 3-4) which respect to this same may only rotate freely, but not change position.

The rotation of the four tie-rods is absolutely alike and driven by a transmission system with geared upper bridge of the known art (0).

All the four tie-rods 1,2,3,4 have two threaded sections respectively with right-hand threading (V1) and with left-hand threading (V2) or vice-versa, an upper one and a lower one.

According to the invention the upper packing group (5) is split into a real cylinder-holding packing and into an upper bridge which supports it 7 which is moved by said threaded coupling (v) and is connected to the packing by interconnection with said approaching-removing means either of higher or lower pressure with hydraulic jacks (8) which carries out the continuous movement respect to said bridge 7.

More in detail for example as it can be seen in figure 1, the lower threading (V2) couples with the lower packing 5i and the upper threading (V1) instead of coupling as in the traditional solutions with the

upper packing, couples with an upper bridge 7.

The upper packing instead is free to slide along said tie-rods (1-2; 3-4), and is tied to said upper bridge by said claimed approaching/removing means with higher or lower pressure with fluid-dynamic cylinder (8).

In such a way, it is possible:

- at first to move the lower packing in alignment with the rolling axis and then;

- during the rolling to move or more or less to press the upper packing (5s) continuously in function of the necessary rolling standards and then the respective upper rolling cylinder (51s) respect to said lower packing (5i) and respective lower cylinder supported by it (51i), which instead remain fixed.

The slight variation of the rolling axis results as having no effects considered the infinitesimal variation of the positions.

Anyway there is nothing which prevents from adopting the more complex solution also at the bottom.

Fig. 3 represents an alike but upturned solution in which is the lower packing 5i to be split and supported by the lower bridge 7 and moved by the claimed approach/removal means with higher or lower pressure with fluid-dynamic cylinder (8) placed between them, while the upper packing (5s) with respective cylinder (51s) would remain fixed.

In the three-high solution of Fig. 4, the intermediate packing 5m and respective intermediate cylinder 51m would remain fixed, while both packings and upper and lower cylinders (5s-51s; 5i-51i) would be moved, both moved in turn by a respective supporting bridge (7) with said approaching/removing means with higher or lower pressure with interconnection fluid-dynamic cylinder (8).

Linear transducers (position sensors) (not shown, of the known art)

supply data to the control central unit (not shown) for determining the hydraulic delivery line oil to the respective hydraulic jacks which make up said approaching/removing means with higher or lower pressure (generally two jacks one for each side 8 in correspondence of said couples of housings at the height of the supporting shoulders and between each couple of tie-rods 1-2; 3-4) for the wished adjustment.

In this way it is possible to adjust in a simple, reliable and safe way the rolling cylinders as wished also during the rolling phase.

Claims

1. Rolling stand of the type involving the possibility of moving orthogonally the respective cylinders (51s, 51i) respect to the rolling axis and in removal or approach one from the other by the sliding of the respective cylinders-holding packings (5s, 5i) along four tie-rods (1,2,3,4) placed at the respective corners of the stand case (9; 90-91), each threaded with right-hand and left-hand opposite screws (V1, V2) for moving in opposition the upper cylinder-holding packing (5s) and the lower cylinder-holding packing (5i), characterized in that:

- at least one of said packings (5s/5i) is made up of two parts (5):

• an external bridge part (7) which is tied in coupling to said respective threadings with right-hand or left-hand screws (V1 and/or V2) of said tie-rods (1,2,3,4) and

• an internal part (5s Fig. 1; 5i Fig. 3; 5s-5i Fig. 4) which makes up the real cylinder-holding packing, which is guided and slides axially along said tie-rods (1,2,3,4) in a corresponding unthreaded part of these same, and in which

- said external bridge part (7) is connected by ties to the corresponding internal part as a cylinder-holding packing (5s Fig. 1; 5i Fig. 3; 5s-5i Fig. 4) by at least one approaching/removing and/or pressure variation means with fluid-dynamic cylinder (8) able to remove or approach or more or less press said internal part which makes up said cylinder-holding packing (5s Fig. 1; 5i Fig. 3; 5s-5i Fig. 4) respect to said bridge (7) on the base of a determined amount of fluid let in or let out by said means for approaching/removing (8).

2. Stand according to claim 1., characterized in that said four tie-rods (1,2,3,4) are kept in a fixed position by allowance of the only rotation by a base or containing base (9, 90) which supports the whole quadrangular

containing and guiding semi-case (91) which besides keeping in position the four tie-rods (1,2,3,4), contains and guides also the respective cylinders-holding packings (5s, 5i).

3. Stand according to claim 1., characterized in that said four tie-rods (1,2,3,4) are controlled rotationally in unison by an upper transmission system (0).

4. Stand according to claim 1., characterized in that the control of said removing/approaching means with or more or less cylinders pressure is carried out by inlet or outlet of a pre-determined amount in volume of fluid according to the standards detected in variation of the rolled section during the rolling process.

5. Stand according to claim 1., characterized in that the position control of said rolling cylinders (51s, 51i) and respective packings (5s, 5i) and their respective movement, is carried out by reaction to what detected by linear transducers connected to the measuring of the distance and/or movement of the same packings.

6. Stand according to claim 1., characterized in that the position control of said rolling cylinders (51s, 51i) and respective packings (5s, 5i), is carried out by means of reaction to what detected by pressure measuring means which are inserted in the jacks of said spacing/approaching means with higher or lower pressure (8).

7. Stand according to claim 1., characterized in that the variation of position in said spacing/approaching means or with higher or lower pressure (8) is carried out by detection of the rolled section standards during the rolling process.

8. Stand according to claim 1., characterized in that the variation of position in said spacing/approaching means or with higher or lower pressure (8) is carried out by detection of the temperature and/or

variation of the temperature constancy in the part of the rolled section during its rolling.

9. Stand according to claim 1., characterized in that the variation of position in said spacing/approaching means or with higher or lower pressure (8) is carried out by detection of the size and/or variation of the size constancy of the part of rolled section during its rolling.

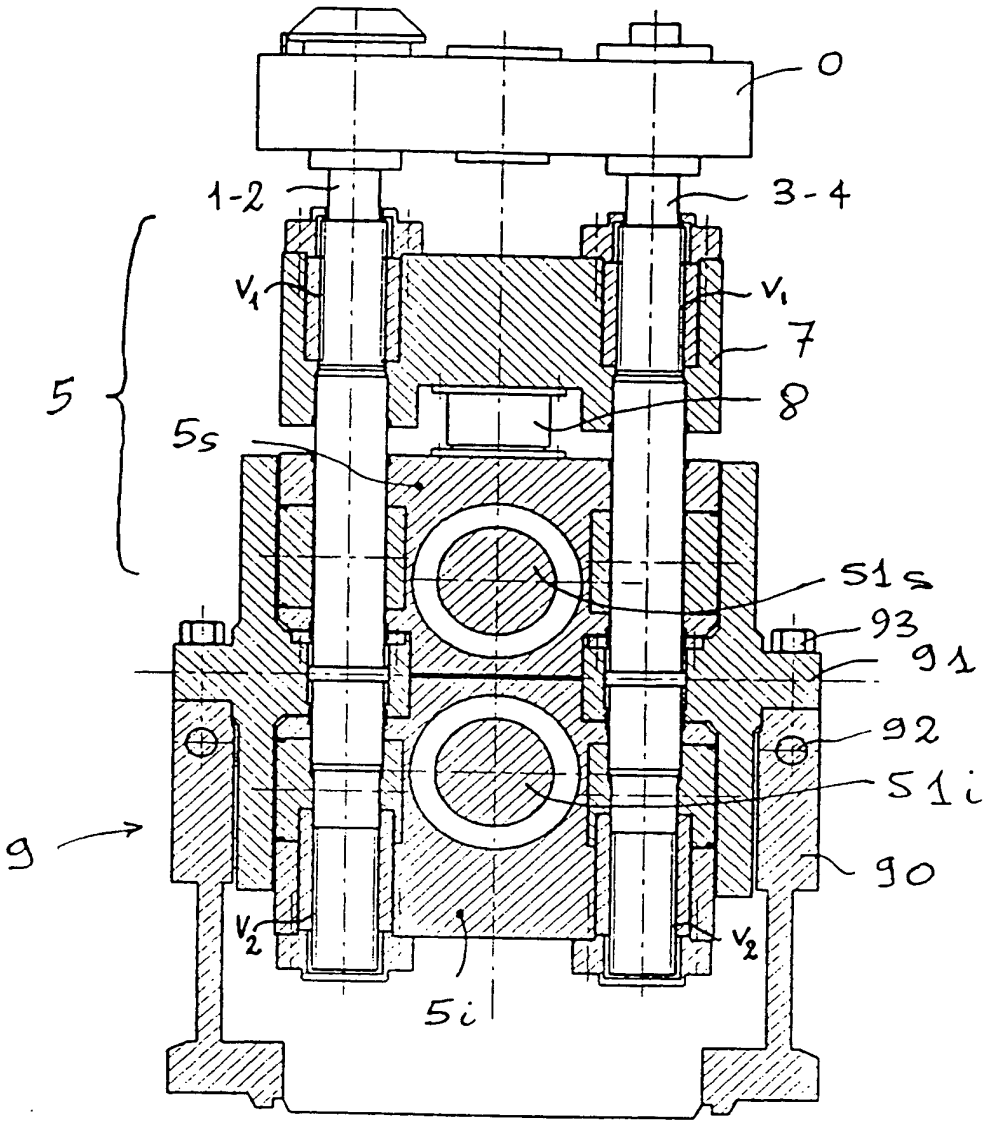

FIG. 1

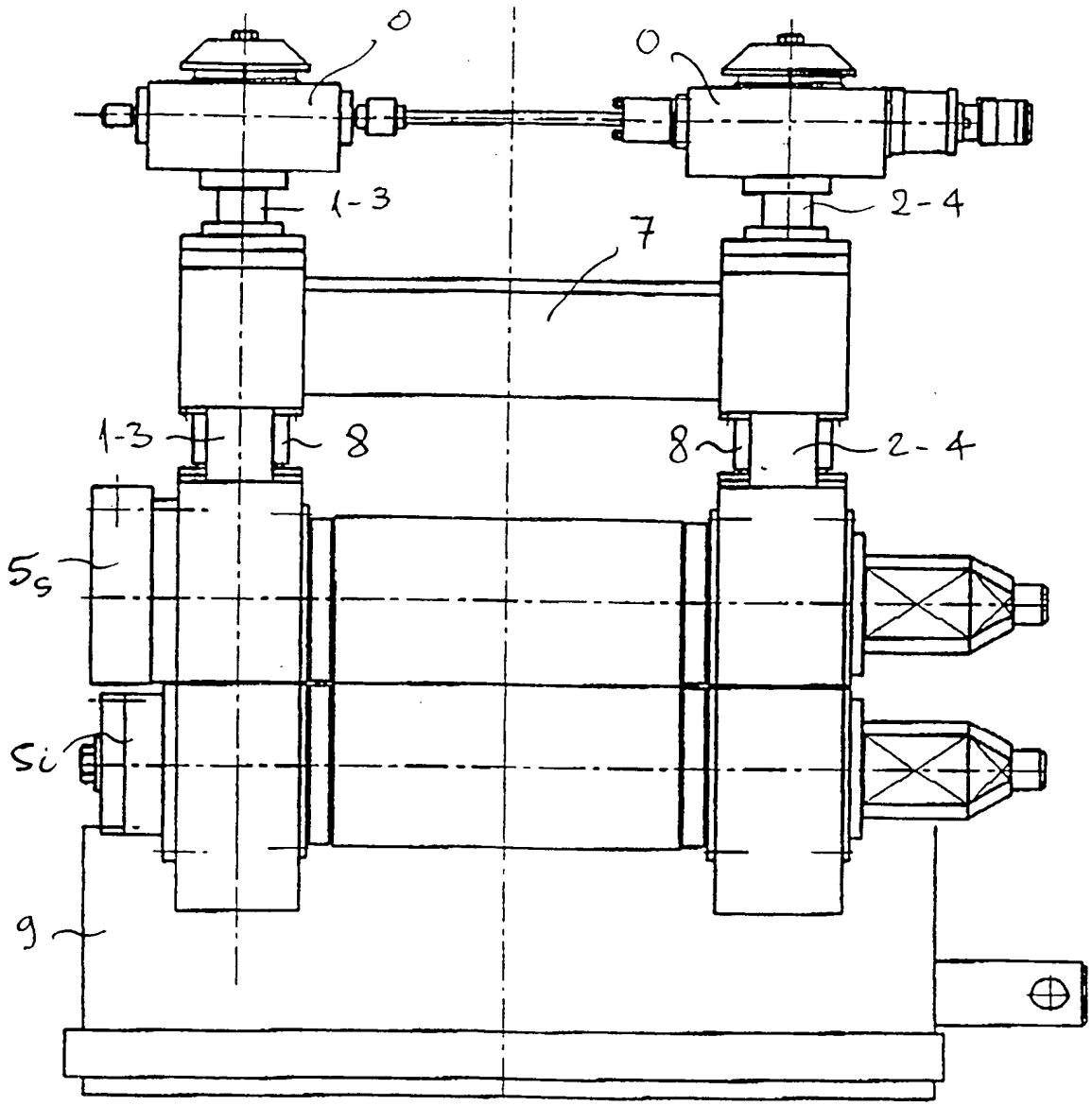

FIG. 2

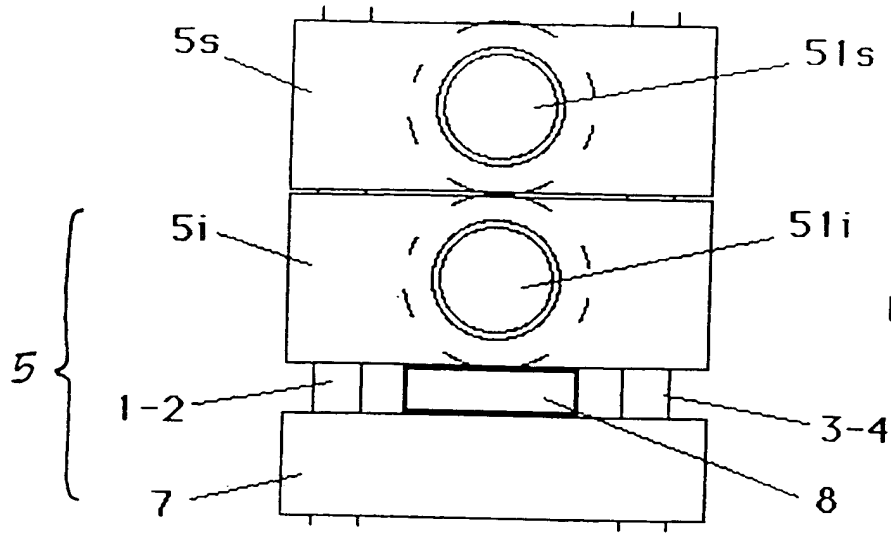

FIG.3

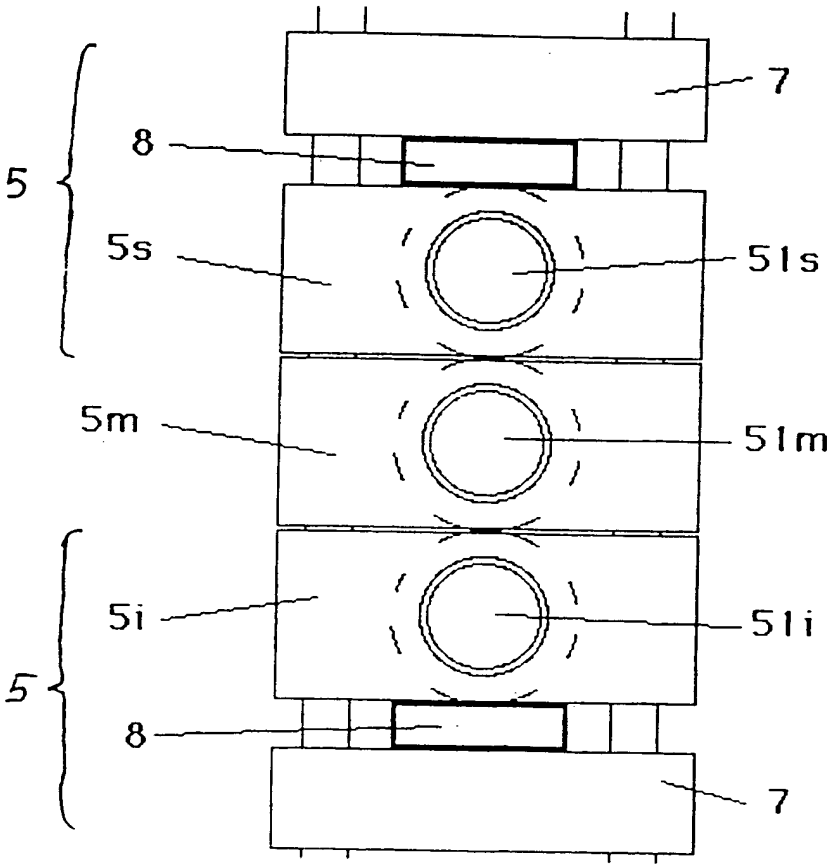

FIG.4

INTERNATIONAL SEARCH REPORT

[redacted] al Application No
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A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 B21B31/04 B21B37/64

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 B21B

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C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	DATABASE WPI Section Ch, Week 8933 Derwent Publications Ltd., London, GB; Class M21, AN 89-239703 XP002055784 -& SU 1 458 040 A (KOLPINSK METAL ENGG) , 15 February 1989 see abstract ---	1-3
A	DATABASE WPI Section Ch, Week 8635 Derwent Publications Ltd., London, GB; Class M21, AN 86-231015 XP002055785 -& SU 1 205 952 A (KOLPINSK VNIIMETMAS) , 23 January 1986 see abstract --- -/--	1,2

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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP 0 659 495 A (MORGAN CONSTRUCTION CO) 28 June 1995 see the whole document	1-3
A	EP 0 166 478 A (POMINI FARREL SPA) 2 January 1986 see the whole document	1-3
A	US 3 516 276 A (BOND HARRY LAURENCE FRED) 23 June 1970 see the whole document	1,4,6,7, 9
A	EP 0 103 989 A (DAVY MCKEE SHEFFIELD) 28 March 1984 see the whole document	1
A	GB 971 409 A (SOCIÉTÉ NOUVELLE SPIDEM) 30 September 1964 see page 2; figures 3,4	1
A	GB 980 448 A (SOCIÉTÉ NOUVELLE SPIDEM) 13 January 1965 see page 3; figure 3	1
A	FR 900 534 A (TRANCHART ANDRÉ) 2 July 1945 see page 2 - page 3; figure 2	1

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PCT/IT 97/00237

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 0659495 A	28-06-95	AU 8164894 A	27-07-95
		BR 9405227 A	01-08-95
		CA 2138809 A	24-06-95
		CN 1108975 A	27-09-95
		JP 8010813 A	16-01-96
		ZA 9410278 A	29-08-95
EP 0166478 A	02-01-86	BR 8502504 A	28-01-86
		US 4715206 A	29-12-87
US 3516276 A	23-06-70	NONE	
EP 0103989 A	28-03-84	CS 8306172 A	18-06-84
		JP 59056904 A	02-04-84
		US 4557130 A	10-12-85
GB 971409 A		FR 1314562 A	12-04-63
GB 980448 A		NONE	
FR 900534 A		NONE	